Surgical Phase Detection Using Deep Learning
Proposal & Plan

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1 Stated topic and goal

Surgical phase recognition plays a crucial role in the era of digitized surgery. Deep learning solutions have seen great success in endoscopic surgeries. Currently, no prior work has investigated its application in skull-base surgery (Cortical Mastoidectomy). This project will benchmark existing DL solutions and create an innovative DL segmentation algorithm in skull-based surgery.

2 Team members, mentor

- **Students**:
  Xucheng Ma, Xiaorui Zhang, Wenkai Luo
- **Mentors**:
  Max Li, Danielle Trakimas, Dr.Francis Creighton, Prof. Mathias Unberath, Prof. Russ Taylor

3 Relevance/importance

Surgical phase recognition has numerous potential medical applications. Such as automatic indexing of surgical video databases and real-time operating room scheduling optimization. It's also a foundation of an intelligent context-aware system, which facilitates surgery monitoring, surgical protocol extraction, and decision support. To be more specific on our project, Mastoidectomy is a highly delicate and complex surgery. There are many facial nerves and blood vessels around the region of operation. It would be ideal for the surgeon to have an intelligent context-awareness system to facilitate decision-making. Our online video segmentation model would be necessary for this system to be aware of the current surgical phase.

4 Short technical summary of approach

Kevin

5 Deliverables

Project deliverables are listed as follows:

- **Minimum Deliverables**

  - New dataset from cortical mastoidectomy videos (with Danielle's help)
  - At least three methods
  - All methods trained and evaluated on the new dataset

- **Expected Deliverables**
  - Experiments and comparison with existing methods
  - Ablation study

- **Maximum Deliverables**
  - Conference paper

6 Timeline & Milestones

Figure 1 shows the project timeline. Milestones are labeled in blue, and deadlines for resolving dependencies are labeled in red. Other entries in the timeline indicate either start point or end point of tasks.

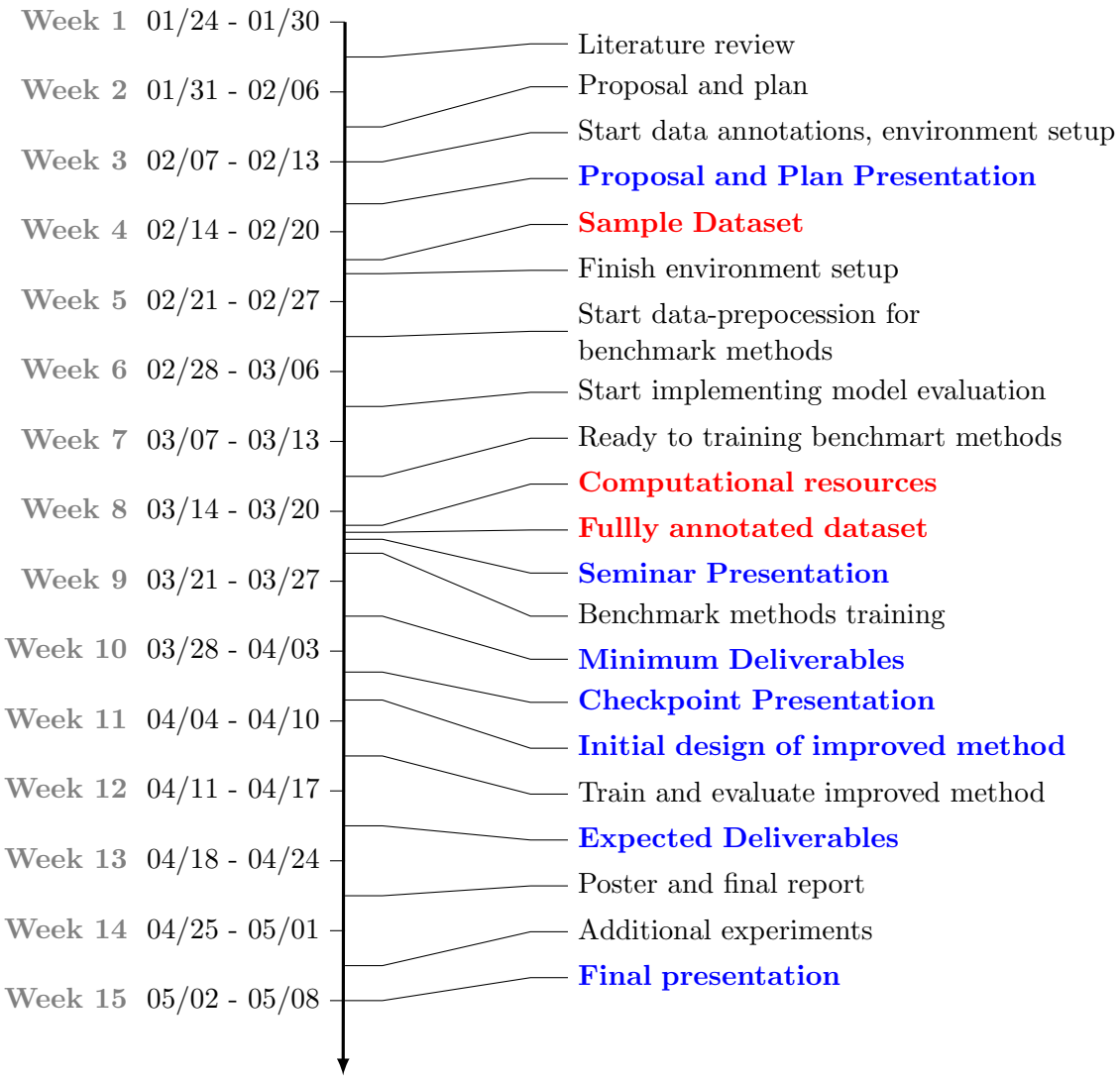

Figure 1: Project timeline, Milestones labeled in blue, Deliverables deadline labeled in red

7 List of dependencies & plan for resolving

Dependencies

Main Dependencies	Sub Dependencies	Contact	Expected Date	Status	Alternative solution
Dataset	Data Generation	Dr. Danielle Trakimas	/	Ongoing	N/A
	Annotation Protocol	Dr. Danielle Trakimas	02/18	Complete	N/A
	Data Annotation	Dr. Danielle Trakimas	03/17	Ongoing	N/A
	IRB Training	Dr. Danielle Trakimas	02/11	Complete	N/A
	IRB Amendment	Dr. Danielle Trakimas	02/25	Ongoing	Use the safe desktop to do the preprocessing of the video, and onedrive streaming will be the alternative solution to address the failure of the IRB amendment
Computational Resources	GPU	Max Li	02/18	Complete	Use the online GPU resource such as Amazon cloud or Colab(Need to get the budget from mentors)
	Server Remote Access	Anton Deguet	02/18	Complete	Set up the computer in a physically available environment, and we need to use that computer to finish the project
Existing Framework & Public Dataset	Framework	Max Li	02/11	Complete	Implement and reproduce the frameworks based on the paper by ourselves using PyTorch
	Laparoscopic Public Dataset (Cholec80)	Max Li	02/11	Complete	Find Another available public dataset
Clinical Advice	Clinical Advice	Dr. Danielle Trakimas	/	Ongoing	Need to find another expert to provide clinical advice

8 Management Plan

- We meet with our mentors and report weekly progress every Friday.
- Slack are used for daily communication.
- All project relevent codes and documentation are managed with git.
- Project progress is monitored with Gantt Chart.

Reading List

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[6] Joonmyeong Choi, Sungman Cho, Jong Chung, and Namkug Kim. Video recognition of simple mastoidectomy using convolutional neural nets: Detection and segmentation of surgical tools and anatomic regions. *Computer Methods and Programs in Biomedicine*, 208:106251, 06 2021.

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